DRAFT

60050

Soil

225.8 grams

LMP: *I'm going over to this crater and get you some of this white soil. I think it is coming off of this rock here, but it looks like caliche. I never thought I'd use that word up here, but that's what the coating looks like.*
CDR*: Gosh, Charlie, it does look like caliche.*
LMP: *Doesn't it look like caliche?*
CDR: *Yeah, but it's just a bunch of white frag, I believe.*

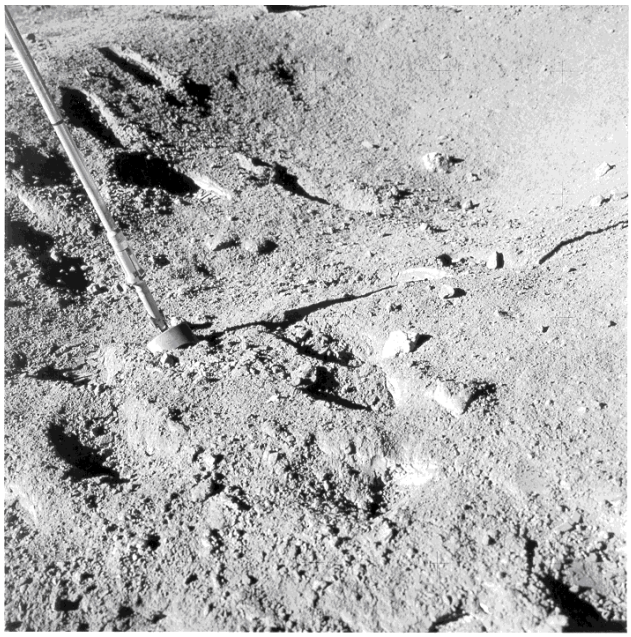


Figure 1: Location of 60050 from side of small crater. AS16-114-18386

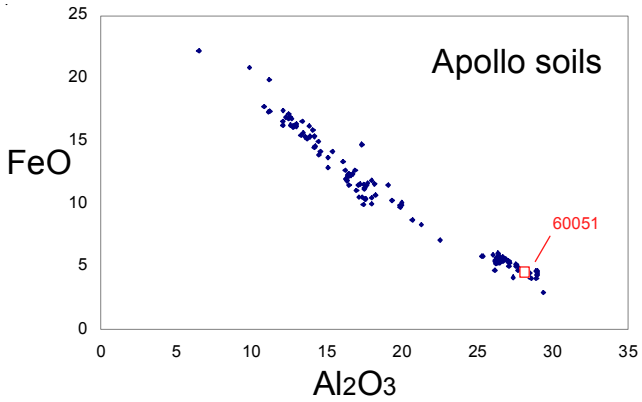


Figure 2: Chemical composition of Apollo soil 60051 compared with all Apollo soils.

Introduction

60050 was collected from the side of a small crater about 20 meters from the Apollo 16 deep drill core near the ALSEP station (figure 1). It was collected because it was lighter colored than the adjacent soil. It was found to include five friable rock fragments 60055 - 59, made of cataclastic anorthosite (table 2). The higher Al_2O_3 and lower REE content of the soil is apparently due to addition of this anorthosite (figure 5).

Petrography

60050 is a submature soil with a maturity index of Is/FeO = 57 (Morris 1978). Butler et al. (1973) and Graf (1993) report the grain size analysis based on sieving (figure 7). Simkin et al. (1973) reported that the 1-2 mm coarse-fines (60052) contained 13 % anorthosite, 20 % plagioclase and only 9 % agglutinate particles. About 3 grams worth of anorthosite were found in the 4-10 mm fraction (figure 8).

Chemistry

This soil is one of the most aluminous of the Apollo soils (figure 2), because of the addition of the friable anorthosite rocks that were collected along with it. The rare-earth-element content is between that of 60501, a soil colleted nearby, and anorthosites (60055 etc) found in the same bag (figure 5). Moore et al. (1973) reported 110 ppm carbon (figure 6).

Cosmogenic isotopes and exposure ages

Wrigley (1973) determined the cosmic-ray-induced activity of ^{26}Al = 115 dpm/kg and ^{22}Na = 56 dpm/kg.

Other Studies

Bogard D.D. and Nyquist L.E. (1973) and Signer et al. (1977) determined the rare gas content and isotopic ratios in bulk soil and various components. It was noted that most of the rare gas was located in the agglutinates. Exposure ages were not calculated.

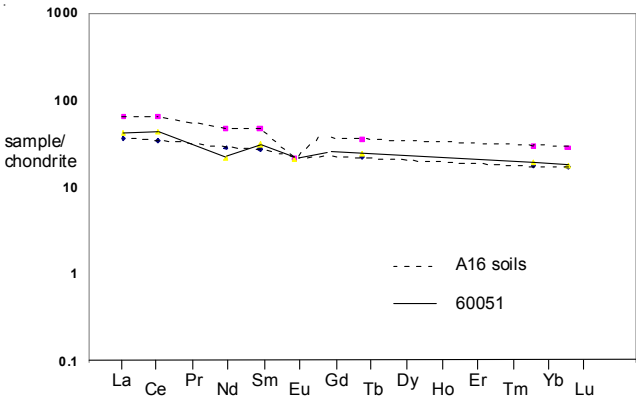


Figure 3: Normalized rare-earth-element diagram for Apollo 16 soils with 60051.

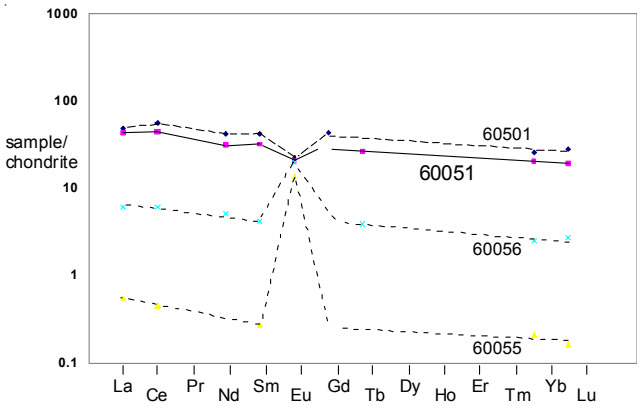


Figure 5: Comparison with friable ferroan anorthosites found in same bag.

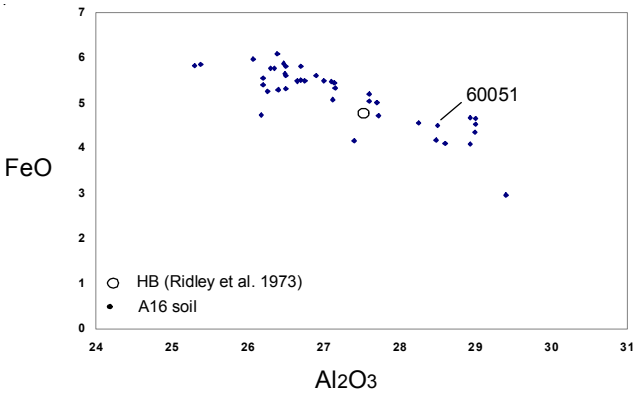
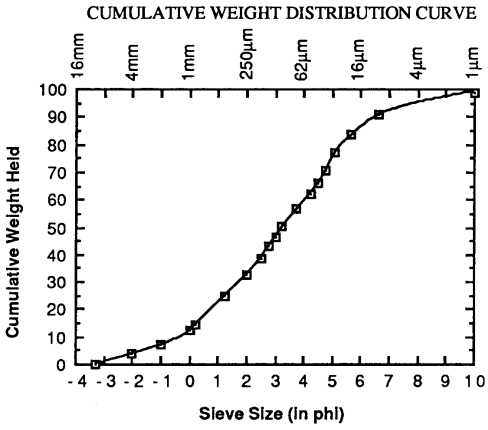


Figure 4: Chemical composition of Apollo 16 soil with average composition of 'highland basalt' (glass) and 60051.



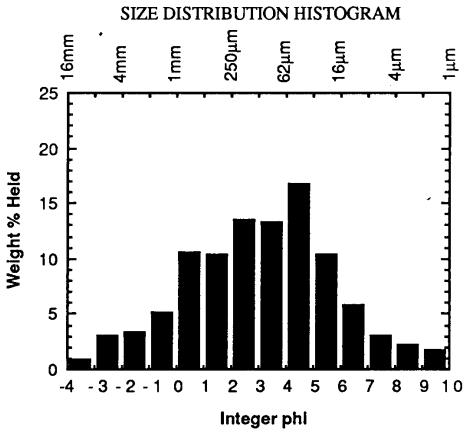


Figure 7: Grain size distribution for 60051 (from Graf 1992; data by King 1973).

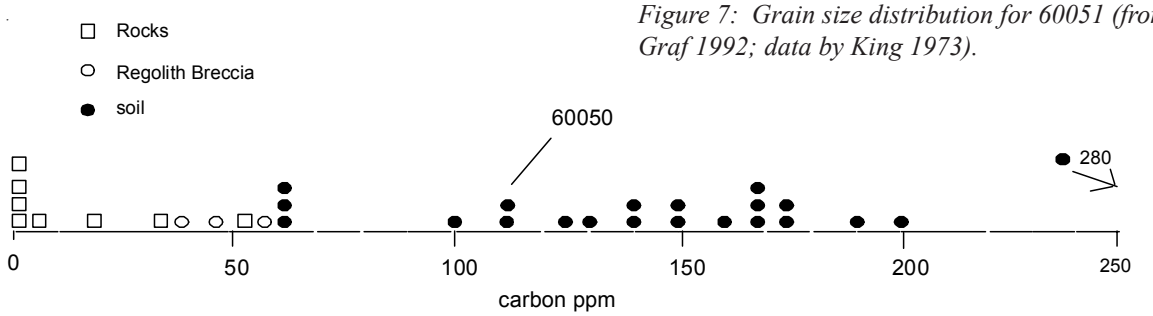


Figure 6: Carbon content of Apollo 16 samples.

Table 1. Chemical composition of 60050.

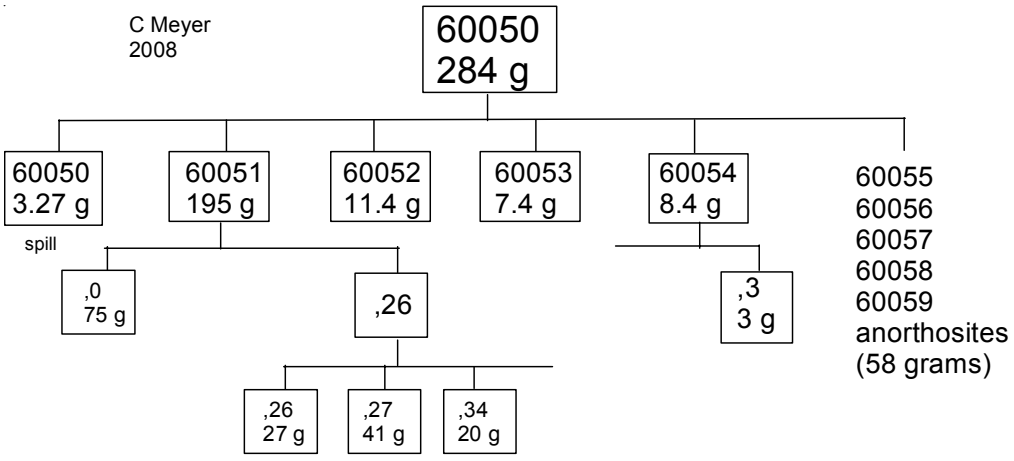
reference	Simkin 73		Korotev 82		McKay86		Korotev 97		Philpotts73		Wrigley73		Fruchter74	
weight			? ?				compiled							
SiO2 %	44.8	(c)					44.8	(b)						
TiO2	0.44	(c)			0.44	(a)	0.44	(b)						
Al2O3	28.5	(c)			28.5	(a)	28.2	(b)					28.1	(a)
FeO	4.5	(c)	3.75	(a)	4.26	(a)	4.47	(b)					4.1	(a)
MnO	0.04	(c)												
MgO	5.05	(c)			5.05	(a)	5.3	(b)						
CaO	16.2	(c)			15.8	(a)	15.9	(b)						
Na2O	0.46	(c)	0.484	(a)	0.484	(a)	0.457	(b)					0.47	(a)
K2O	0.14	(c)					0.12	(b)	0.096	(e)	0.0988	(f)		
P2O5														
S %														
sum														
Sc ppm			7.83	7 (a)	7.75	(a)	7.75	(b)					8.1	(a)
V	7	(d)	19											
Cr	730	(d)	612	580 (a)	594	(a)	615	(b)					611	(a)
Co	27	(d)	21.3	13.2 (a)	19.5	(a)	24.7	(b)					23.6	(a)
Ni	270	(d)	250	200 (a)	260	(a)	342	(b)						
Cu	7	(d)												
Zn														
Ga	3	(d)												
Ge ppb														
As														
Se														
Rb									2.34	(e)				
Sr	205		165		200	(a)	188	(b)	173	(e)				
Y	28													
Zr	110		165		160	(a)	150	(b)						
Nb														
Mo														
Ru														
Rh														
Pd ppb														
Ag ppb														
Cd ppb														
In ppb														
Sn ppb														
Sb ppb														
Te ppb														
Cs ppm			0.1		0.12	(a)	0.11	(b)						
Ba	140		108		110	(a)	110	(b)					130	(a)
La			10.06	10.2 (a)	10	(a)	10	(b)					9.9	(a)
Ce			27	26.5 (a)	26.4	(a)	26.6	(b)	26.8	(e)			25.2	(a)
Pr														
Nd					10	(a)	14	(b)	16.9	(e)			16	(a)
Sm			4.88	4.7 (a)	4.6	(a)	4.7	(b)	4.84	(e)			5.1	(a)
Eu			1.12	1.01 (a)	1.195	(a)	1.14	(b)	1.07	(e)			1.2	(a)
Gd														
Tb			1.04	1 (a)	0.89	(a)	0.96	(b)					1	(a)
Dy									6.15	(e)				
Ho														
Er														
Tm														
Yb			3.42	3.3 (a)	3.16	(a)	3.31	(b)					3.5	(a)
Lu			0.501	0.46 (a)	0.446	(a)	0.47	(b)					0.5	(a)
Hf			3.89	3.4 (a)	3.6	(a)							3.3	(a)
Ta			0.526	0.5 (a)	0.44	(a)							0.4	(a)
W ppb														
Re ppb														
Os ppb														
Ir ppb			7.6		8.1	(a)	10.9	(b)						
Pt ppb														
Au ppb					4.6	(a)	7.1	(b)						
Th ppm			1.76	1.7 (a)	1.8	(a)	1.73	(b)			1.68	(f)	2	(a)
U ppm			0.46		0.45	(a)	0.46	(b)			0.42	(f)		

technique: (a) INAA, (b) compiled, (c) fused-bead e. probe, (d) emis. spec., (e) IDMS, (f) radiation counting

Table 2: Walnut Samples from 60050 (DB355)

	weight	Ryder's term	ref
60055	35.48	cataclastic anorthosite	Warren and Wasson 1978
60056	16.07	cataclastic anorthosite	Bersch et al. 1991
60057	3.1	cataclastic anorthosite	
60058	2.12	fragmental breccia	
60059	1.05	cataclastic anorthosite	
also	coarse fines		
60054,3	3	cataclastic anorthosite	Marvin 72

Figure 8: Photo of some (anorthositic) coarse-fines from 60050 bag. Scale bar is marked in mm. NASA S72-46349. (these are NOT "caliche")



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